



European Lakes Under Environmental Stressors

(Supporting lake governance to mitigate the impact of climate change)

EULAKES model as support for decision making

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** Fondazione Edmund Mach

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EUROPEAN UNION
EUROPEAN REGIONAL
DEVELOPMENT FUND

The idea

- Model development

The structure of the Web portal

- Overview of the outputs
- Search Engine
- WebGIS
- OGC services
- Prediction models

<http://www.eulakes-model.eu/>





EuLakes Model

The EuLakes model represents a new **integrated approach to investigate, map and compare vulnerability of big lakes**.

The outputs of the projects are here collected, managed, shared and interpreted to be easily reachable and understood by lakes' stakeholders and decision makers in a rapid and efficient way **to support the environmentally educated decision making**.

The outputs are explained for their importance and use to the lakes's stakeholders, and a specifically built **geographical interface** allows the viewer to easily localize the data concerning his/her specific area of interest.

The Lakes

Garda, Balaton, Neusiedl and Charzykowskie lakes have different geographical and morphological features, different trophic status and human exploitation. However, the four lakes have **primary socio-economic importance** within their respective regions, due to the multiple use of their waters (i.e. irrigation, drinking, tourism, etc.) and surrounding areas.

For this reason they were considered for the EULAKES project, in order **to assess the role of climate change on lakes ecosystems and evaluate the various threats** menacing the future use of these important freshwater resources.



<http://www.eulakes-model.eu/>



Overview of the Outputs



Search Engine
Full text search



webGIS
Geographically referenced
outputs



OGC Services
Open Geospatial Consortium
standards



Prediction models

EuLakes Model

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- [Home](#)
- [Overview of the Outputs](#)
- [webGIS](#)
- [Search engine](#)
- [OECD model](#)
- [OCG Services](#)
- [EuLakes Project](#)

Descriptions

Garda, Balaton, Neusiedl and Charzykowskie lakes have different geographical and morphological features, different

Search engine

webGIS

Overview of the outputs

Overview of the outputs

Past

These researches are useful to reconstruct the secular evolution of the ecological status of the lakes, defining therefore baselines (the lake status before anthropological impact) and to establish restoration objectives to reach.

- Ecological evolution: lake sediment studies
- Colonisation History by Harmful Algae
- Water quality time series studies (2004-2010)

Present

Innovative researches carried out within the EuLakes projects to improve our current understanding of the state of the lake.

- Existing monitoring systems
- Shorezone Functionality Index

Future

Climatic models have been created to describe the probable variation in temperature, precipitation, wave heats, extreme events and other climate factors from present to year 2100.

- Lakes Vulnerability

Lakes Management

- Lake stakeholders
- Existing lake management plans and strategies

Search Engine

Search for:

Category:
 Results per page:
 Overview of the outputs
 Lake description
 webGIS

Match: ☒ any search words ☐ all search words

Search results for: «Cyanobacteria» in all categories

Cyanobacteria

18 results found.

Refine your search by category: [Overview of the outputs](#) (13)



1. Nuisance cyanobacteria species - EuLakes Model

[\[Overview of the outputs\]](#)

... **Cyanobacteria** (blue-green algae) are gram negative bacteria. They represent the most primitive and ancient organisms with oxygen-generating photosynthesis on earth (Sandeep ...

Terms matched: 1 - Score: 350 - 18k - URL: <http://www.eulakes-model.eu/outputs/nuisance-cyanobacteria-species.html>



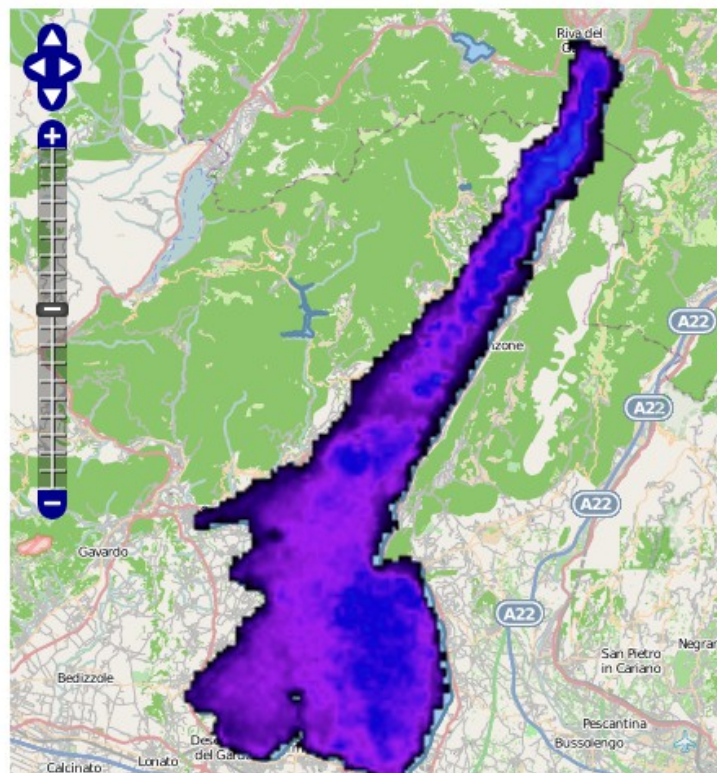
2. Bathymetry Study (Lake Charzykoskie only) - EuLakes Model

[\[Overview of the outputs\]](#)

... **Cyanobacteria** are a widespread group of organisms colonizing all ecosystems. They are common inhabitants of freshwater bodies throughout the world, several of them form blooms that accumulate

webGIS

Select the lake of your interest:



Details - Lake Garda

Map layers

- ▶ Remote sensing data
- ▶ Protected area
- ▶ Shorezone data
- ▶ Base data
- ▶ OpenStreetMap

▶ Lakeinfo

▶ Featureinfo

▶ Credits

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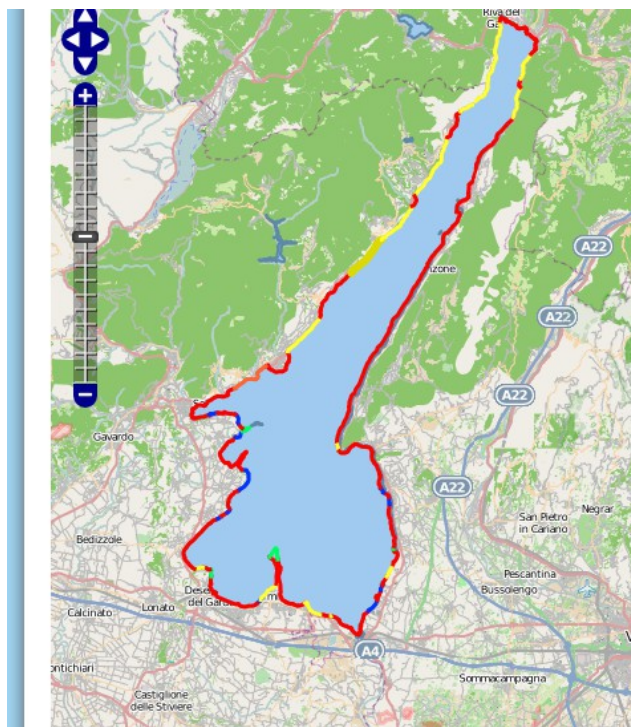
Help

The layers with this
symbols **i** are query-able,
so you can click on a
feature and obtain it's
values

Legend

Chlorophyll "a" 2010

Georeferenced data: base cartography + Projects
outputs + remote sensing data + climate change data



Details - Lake Garda

Map layers

Lake info

Feature info

Vegetation heterogeneity:	Vegetation absent or exotic
SFI:	3
Length:	3.81361 km



3.2.7 Homogeneous stretch 70
This stretch is mainly composed by steep bare rocks falling into the water. The SFI software favours the absence of grass in this case, but in reality I think that, even if this stretch is a very natural,

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Help

The layers with this symbols **i** are quick so you can click on feature and obtain values

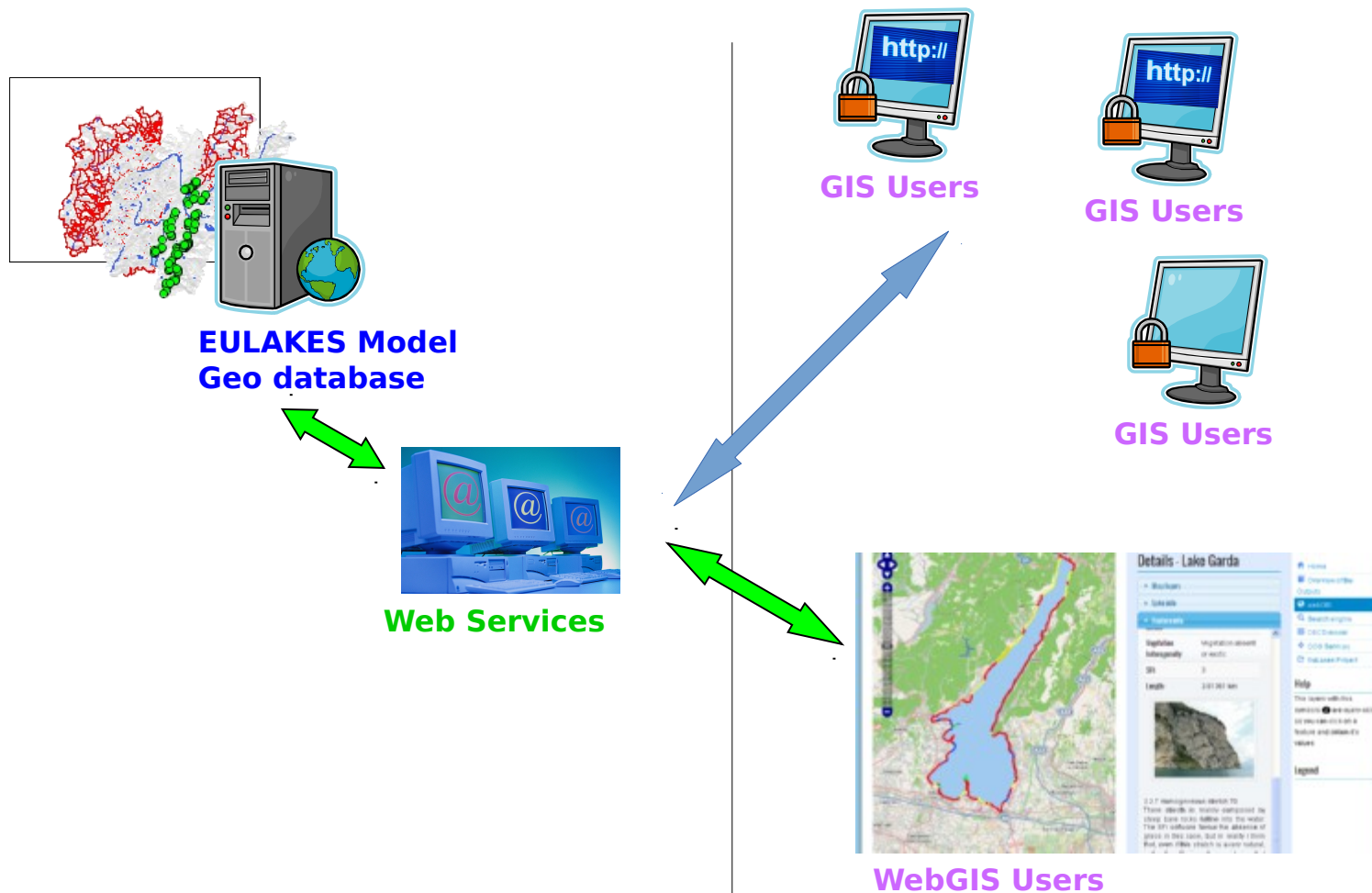
Legend

- ☐ Presence of reed
- ☒ Shorezone Functionality Index **i**
- Base data**
 - ☐ Wastewater treatment plants **i**
 - ☐ Jobs
 - ☐ Pipes
 - ☐ Hydroelectric power plants **i**
 - ☐ Municipality **i**
 - ☒ Other lakes **i**
 - ☐ Streams **i**
 - ☐ Catchment area
 - ☐ Glaciers of Garda basin
 - ☐ Landuse (Corine)
 - ☐ Beach
 - ☒ Lake boundary

Layer Query

Feature Information:

- Reports broken down into small pieces (i.e SFI)



OGC Web Services for the standardization and interoperability of the geospatial data (Web Map Service)

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Eulakes Balaton

Layers:

- Balaton
- balaton_cdom_2004
- balaton_cdom_2005
- balaton_cdom_2006
- balaton_cdom_2007
- balaton_cdom_2008
- balaton_cdom_2009
- balaton_cdom_2010
- balaton_chl_2004
- balaton_chl_2005
- balaton_chl_2006
- balaton_chl_2007
- balaton_chl_2008
- balaton_chl_2009
- balaton_chl_2010
- balaton_tsm_2004
- balaton_tsm_2005

getCapabilities getUri

Layer: Balaton

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OCG Services

- Common data for Eulakes project
- Eulakes Balaton**
- Eulakes Charzykowski
- Eulakes Garda
- Eulakes Neusiedl

Web Services for the standardization and interoperability of the geospatial data (Web Map Service)

- Preview of the layers
- “Get capabilities”: download directly the description of each lake service + future climate change scenairios
- “Url”: obtain the address where the service is stored

OECD

Select the lake of your interest:



The lake could be

Ultra-oligotrophic	Phosphorus mean	chlorophyll mean	chlorophyll max	Secchi disk depth
Ultra-oligotrophic	≤ 4.0	≤ 1.0	≤ 2.5	≥ 12.0
Oligotrophic	≤ 10.0	≤ 2.5	≤ 8.0	≥ 6.0
Mesotrophic	10.0-35.0	2.5-8.0	8.0-25.0	6.0-3.0
Eutrophic	35-100	8.0-25.0	25.0-75.0	3.0-1.5
Hypertrophic	≥ 100.0	≥ 25.0	≥ 75.0	≤ 1.5

- predict the interactions between chlorophyll, phosphorous and water transparency, based on the OECD equations

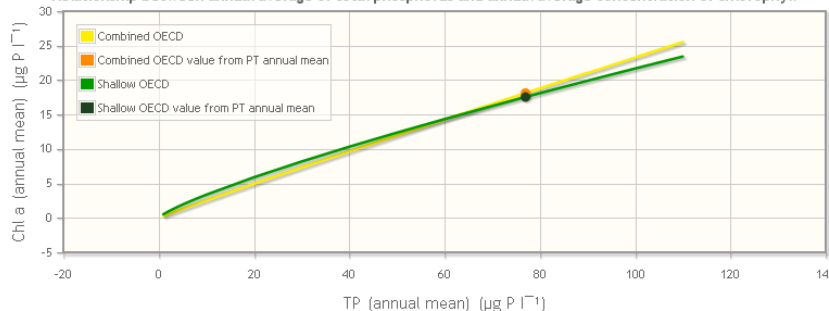
Lake Neusiedl

Value for annual mean phosphorus

77

Update graphs

Relationship between annual average of total phosphorus and annual average concentration of chlorophyll



Equations used: Combined OECD

$$y = 0.28 \cdot x^{0.96}$$

Model predictions: Cyanobacteria concentration

Cyanobacteria

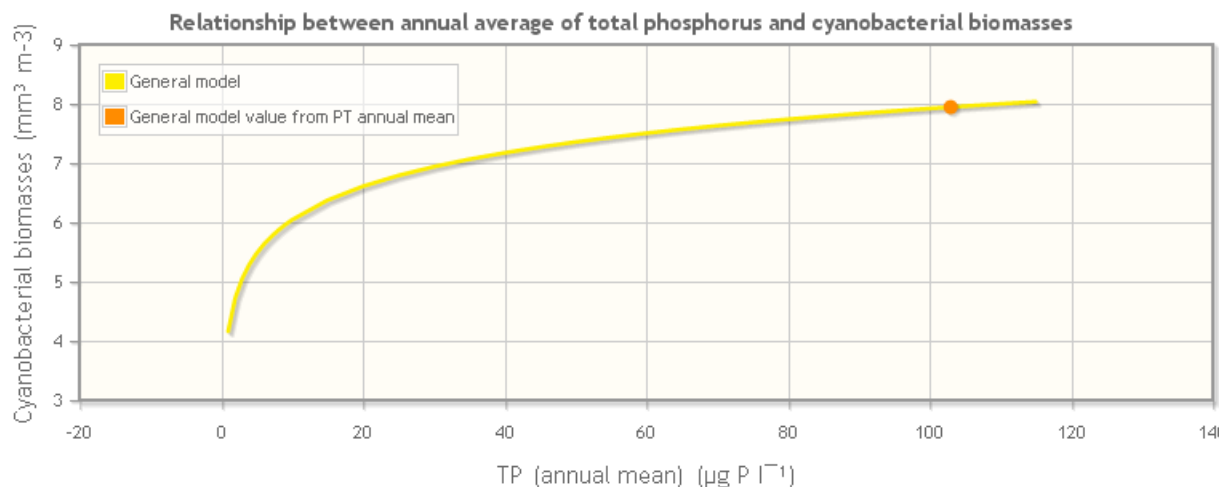
Select the lake of your interest:



Lake Charzykowski

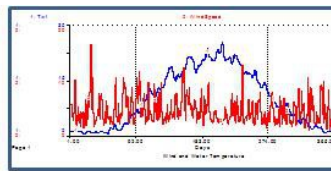
Value for annual mean phosphorus

Update graphs

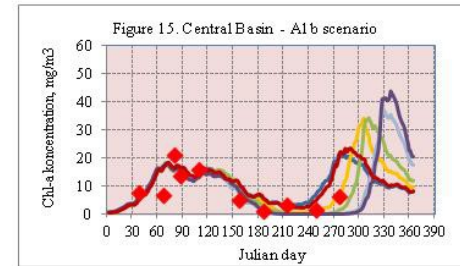


- predict cyanobacteria concentration in correlation with phosphorus and chlorophyll presence

Model predictions: chlorophyll-a prediction model concept and input & output data types



Air temperature, wind, solar
radiation
(Time series)

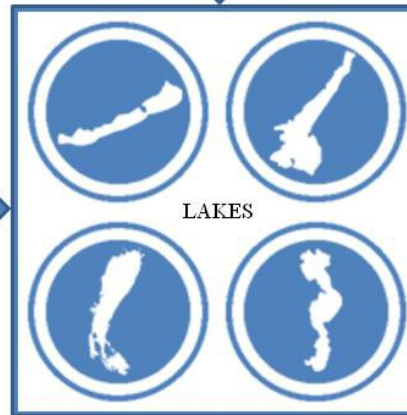


Water temperature, suspended sediment concentration,
phosphorus, algae biomass & chlorophyll-a concentration
(Time series)

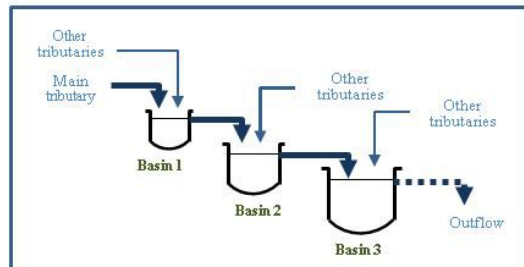


Water Balance
(Inflow,
Precipitation,
Evaporation,
Outflow)

Influent nutrient
concentrations
(Time series)



Physical model is
different for each lake



Morphological parameters
(number of sub-basins, depth,
area, volume, stratification,
location of inflows and
outflow(s))
Biochemical and physical
constants, parameters and
functions
Sediment P content, initial
values



EuLakes

EULAKES model results











Change of summer maximum chlorophyll-a concentrations in the 4 basins of Lake Balaton as a function of climate change and nutrient load





Years (decades)	Climate Scenario A1b Phosphorus load reduction: 0 %	Climate Scenario A1b Phosphorus load reduction: 50 %
2011-2020		
2031-2040		
2051-2060		
2071-2080		
2091-2100		

Legend				
% of reference year (1994)	<100	100 - 140	140 - 180	>180

EULAKES model results

Change of annual average and annual maximum chlorophyll-a concentrations in the 3 basins of Lake Neusiedl as a function of climate change

Years (decades)	Climate Scenario A1b Annual average	Climate Scenario A1b Annual maximum
2011-2020		
2031-2040		
2051-2060		
2071-2080		
2091-2100		

Legend				
% of reference year (1994)	<100	100 - 140	140 - 180	>180

Internet Address of the EULAKES Model Web site:

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